DOE Wire Development Workshop

Session IV - Conductor Design

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2G Wire design – BSCCO Customers

What does the customer want?

1. "Form fit function" to 1G HTS wire
   - Product will at least meet the 1G customer specifications (electrical, mechanical, physical, environmental)
2. Price
   - Significantly less than G1 wire – to justify the change
3. Additional attributes
   - Higher Je vs. B and T, resistivity, stability

The device builder does not care about what is inside

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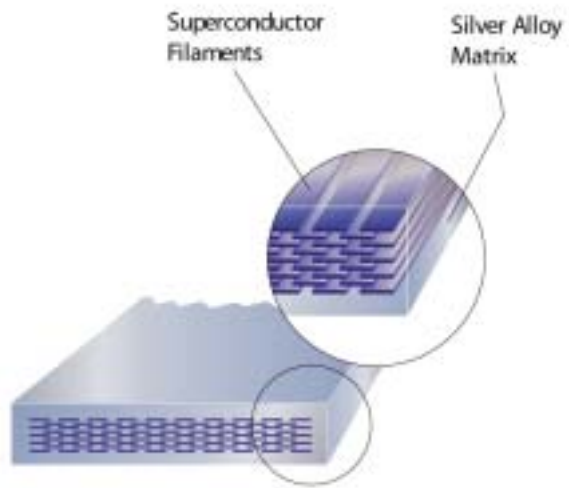
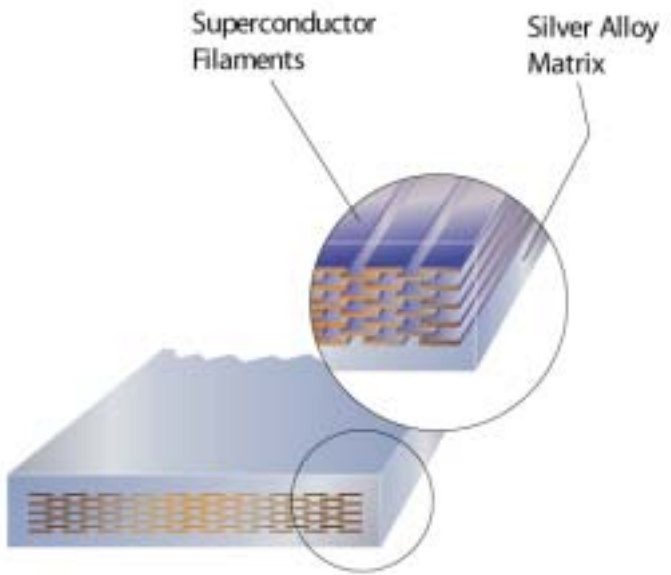
HTS Applications Now Require Specialized Wires

- Different wire types are required for each application
  - Cables
  - Motors
  - Generators
  - Magnets



Basic Building Block

AMSC's Four Multifilamentary Wire Products



Basic Building Block

High Current Density

High Strength

Hermetic

Compression Tolerant

First Generation Wire Maturity Leads to Product Differentiation

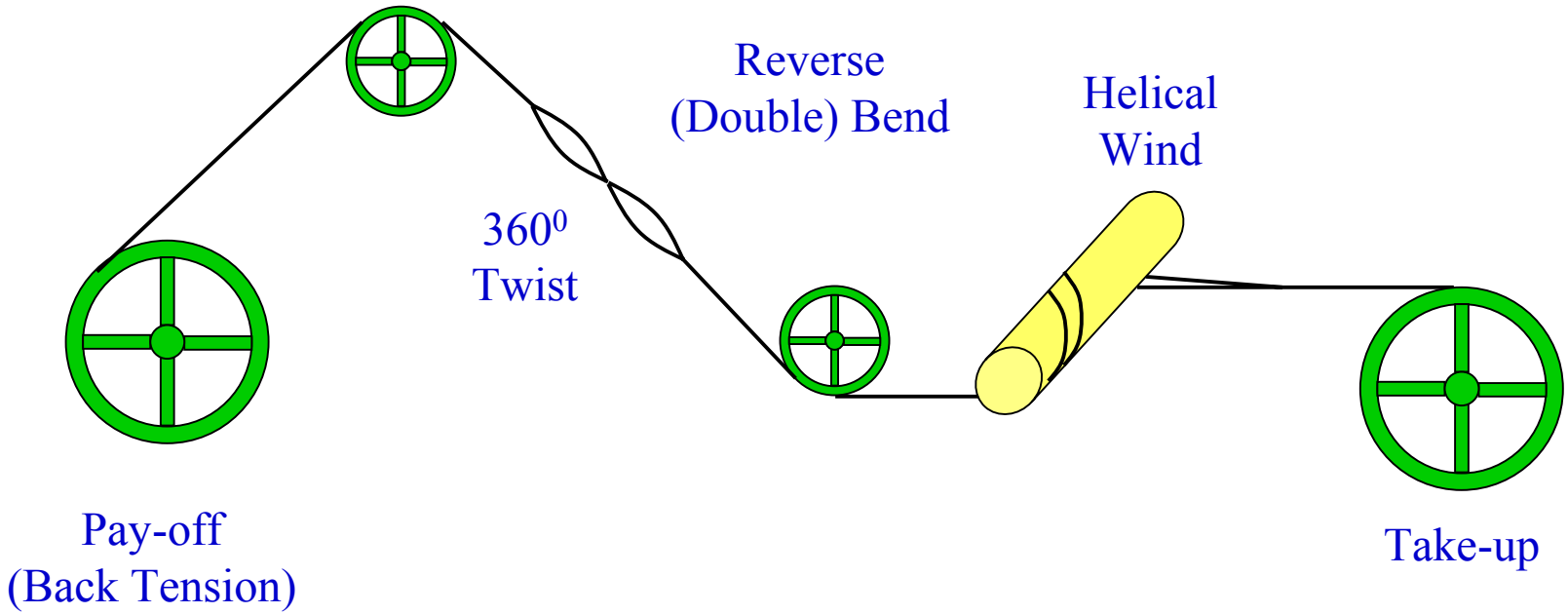
Product Specifications - Bi-2223 High Strength Reinforced Wire:

		BSCCO - MFC Full Commercial
	Geometry:	High strength clad
	Ave. width:	4.1mm
	Ave. thickness:	0.30mm
	Min Ic (77K, sf):	150A
	Min Je (A/cm2):	12,200
→	Critical Stress 77K:	265MPa
	Critical Stress RT:	150MPa
→	Critical Strain 77K:	0.4%
→	Compress Strain tol. 77K:	0.3%
	Min bend Diameter:	70mm
	Laminate material:	Stainless Steel
→	Hermetic:	Yes
	Piece Length:	100-1000m

→ = Not all required in one wire

Reliability: Mechanical Aging Test

We must demonstrate that 2G will meet all requirements



Test Designed to Simulate Cable Stranding Process

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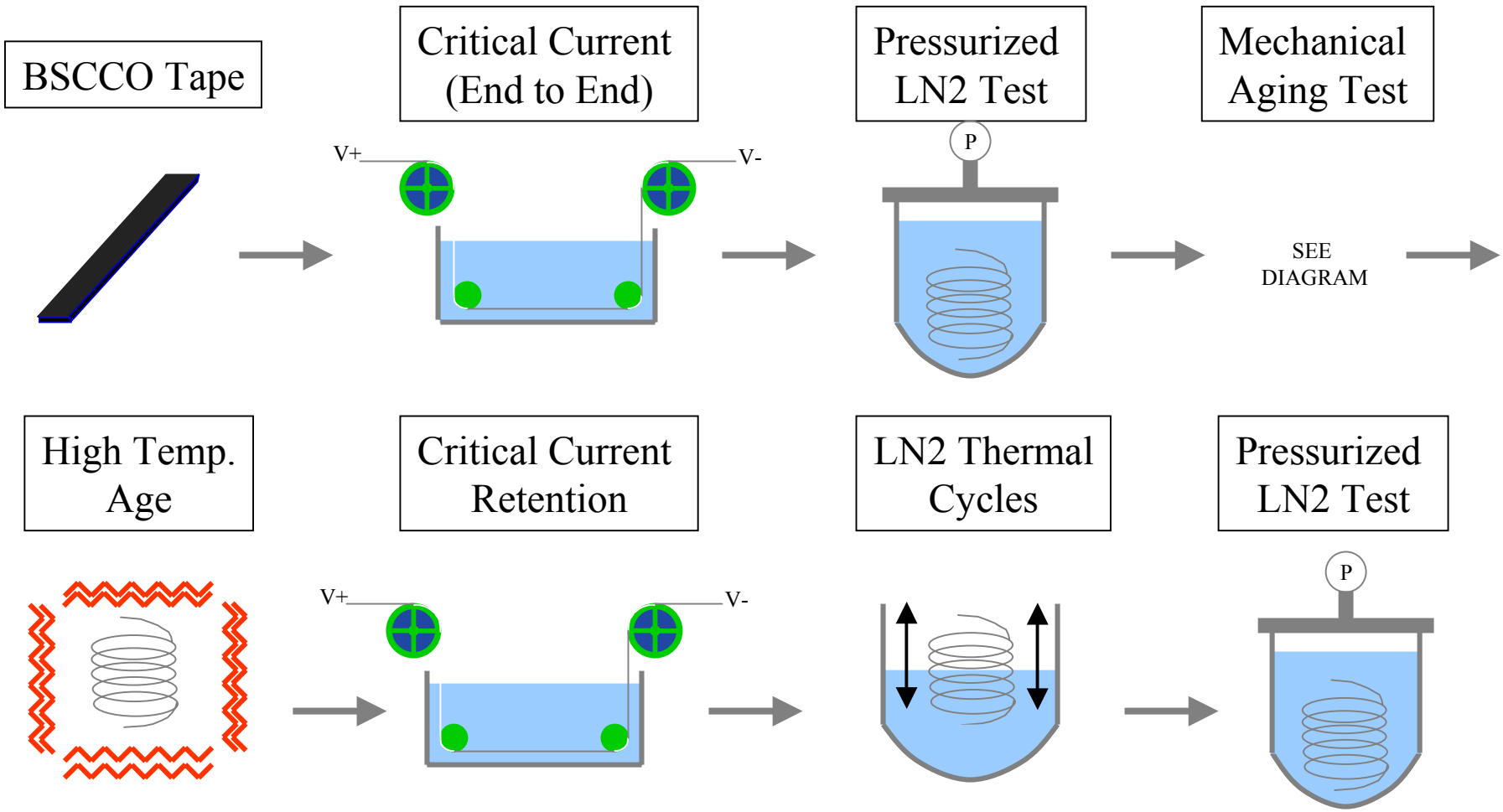
BSCCO Tape
Reliability Testing Procedure



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Additional Criteria

- Jc vs. B (30-80K)
- AC loss
- Joints
- Insulation
- Thermal cycling
- Mechanical aging
- Environmental aging
- Fatigue
- Electrical and thermal stability
- Magnetic susceptibility

ORNL Wire Procurement will enable early Cable and Magnet performance data

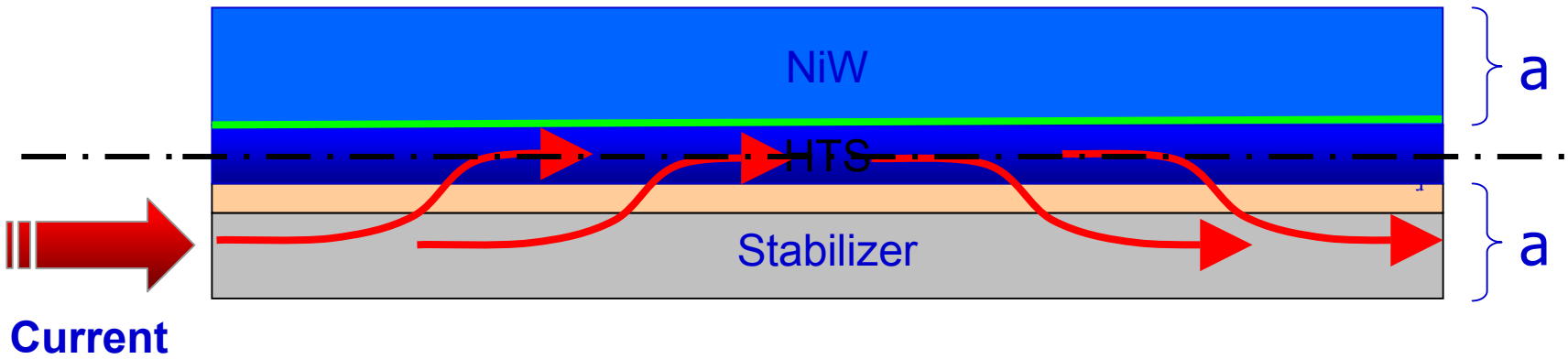
Key testing needed in CY 2003

"Neutral Axis" Conductor Design

electrical stability by Cu stabilizer (50-75 μm)

high mechanical stability – HTS along centerline

simple current injection



Product Specifications vs. Bi-2223 High Strength Reinforced Wire:

	BSCCO - MFC Full Commercial	YBCO - CCC Full Commercial	POP
Geometry:	High strength clad	Neutral Axis	✓
Ave. width:	4.1mm	4.1mm	1 cm
Ave. thickness:	0.30mm	0.15mm	✓
Min Ic (77K, sf):	150A	100A	120A
Min Je (A/cm2):	12,200	16,000	8,000
Critical Stress 77K:	265MPa	200MPa	✓
Critical Stress RT:	150MPa	150MPa	✓
Critical Strain 77K:	0.4%	0.4%	✓
Compress Strain tol. 77K:	0.3%	0.3%	✓
Min bend Diameter:	70mm	70mm	<30mm
Laminate material:	Stainless Steel	Copper	✓
Hermetic:	Yes	Yes	
Piece Length:	100-1000m	100-1000m	1 m

2G Observations

- Mechanical properties similar to 1G
- Electrical performance similar to 1G
  - Irreversibility field suggests significant Jc vs. B improvement possible
  - Anisotropy Min. Jc at 45 degrees, Max. Jc at 90 degrees.
- AC hysteretic losses lower (proportional to filament thickness) dimension perpendicular to applied ac field.

Possible New Markets Enabled by 2G

- Airborne Generators/Military systems

  Increased Jc vs. B @ 50K = reduced system weight

- FCLs

  High resistance stabilizer permits rapid normal zone

- Transformers

  Possible reduced AC hysteretic loss and system cost

End

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